

(12) UK Patent Application (19) GB (11) 2 303 374 (13) A

(43) Date of A Publication 19.02.1997

(21) Application No 9517111.2

(22) Date of Filing 21.08.1995

(30) Priority Data

(31) 9514642 (32) 18.07.1995 (33) GB

(71) Applicant(s)

Laporte Industries Limited

(Incorporated in the United Kingdom)

3 Bedford Square, LONDON, WC1B 3RA,
United Kingdom

(72) Inventor(s)

Jameel Barlas

(74) Agent and/or Address for Service

Urquhart-Dykes & Lord
91 Wimpole Street, LONDON, W1M 8AH,
United Kingdom

(51) INT CL⁶

C09D 5/24 , B32B 19/04

(52) UK CL (Edition O)

C3V VABS

B2E EKB E415S E418T E421T E436T E442S E450T
E482S E489T E491S E605T

C3W W203 W204 W213 W218 W224 W301 W302
W304 W305 W314 W316 W328

U1S S1220 S1424 S1425 S2122 S2206

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No91-257863/35 & JP3169540A

(58) Field of Search

UK CL (Edition O) C3V VABP VABQ VABR VABS

VABT VABX

INT CL⁶ C09D

Online: WPI

(54) Surface coating composition

(57) A surface-coating composition, for application as a protective surface-coating to plastics or glass articles or equipment, the composition comprising a synthetic mineral capable of imparting conductive properties to the composition, a binder for the mineral comprising an aqueous emulsion, suspension or dispersion of a polymer, and a low temperature cross-linking agent for the polymer. The following compounds may be present in the composition : synthetic hectorite, polyphosphate, pyrophosphate, polar solvent, urethane, acrylic and melamine resins, polyaziridine, zirconium compound and organo metallic compound.

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Surface-coating composition and method of application.

This invention relates to a surface-coating composition for application to plastics or glass articles as a protective film.

Equipment or materials in current use are often made from, or comprise, relatively non-conductive plastics materials which may be subject to the build-up and periodic discharge of static electricity. The existence of a surface charge tends to encourage the deposition of dust particles, may interfere with the application of emulsion-type protective coatings to the surface and may cause damage in the case of sensitive electronic equipment. It is possible to reduce the build-up of static electricity by including a conductive, material such as a conductive powder, as an ingredient in the plastics material itself or by providing earthing wires or strips embedded in the plastics material. It would be desirable to provide a protective surface-coating composition which could be applied readily to a surface of articles or equipment, which is sufficiently hard-wearing to survive normal use, which is preferably transparent or translucent so that the original surface finish of the plastics material is not obscured and which has good conducting properties.

The present invention provides a surface-coating composition, for application as a protective surface-coating to plastics or glass articles or equipment, the composition

comprising a synthetic mineral capable of imparting conductive properties to the composition, a binder for the mineral comprising an aqueous emulsion, suspension or dispersion of a polymer and a low temperature cross-linking agent (curing agent) for the polymer. The invention also provides a process for the application of the protective surface-coating to articles or equipment comprising applying a layer of the composition to a surface of the articles or equipment and maintaining the layer under cross-linking conditions to form a coating.

EP-A-0 374 937 describes a heat-sensitive recording material having a back-coating comprising a synthetic hectorite and a soap-free emulsion-type binder. The synthetic hectorite may be fluoride -containing or fluoride-free and may be gel-forming or sol-forming. The purpose of the back-coating is to reduce blockages in the recording equipment during use and there is no conception of the use of the hectorite/binder composition as a protective coating. If a protective coating is required this is applied as a separate coating.

The synthetic mineral which is used in the composition of the present invention should preferably have a relatively highly charged siliceous anionic lattice indicated by a base exchange capacity of at least 80 m eq/100g. Particularly preferably the exchange capacity is at least 100 and possibly up to 170 m eq/100g. The synthetic mineral is preferably finely divided since this will enable a relatively homogeneous distribution in the composition. The synthetic mineral is preferably a clay mineral, for example, preferably, a synthetic hectorite such as, for example that available under the Trade Mark Laponite from Laporte Absorbents. It is further preferred that the synthetic clay mineral has content of hydroxyl groups of at least 2, particularly preferably at least 3, and possibly up to 4, per 8 atoms of silicon. These hydroxyl groups are available for reaction with the functional groups of some of the polymeric binders, for example with isocyanate groups of a polyurethane binder, and this combination is a preferred selection within the ambit of the present invention. Preferred grades of Laponit

synthetic hectorite are the fluoride-free RD and RDS grades which fulfill the preferences expressed above as to hydroxyl content.

The RDS grade of Laponite synthetic hectorite, and also the S, and XLS grades, contain 6.5% by weight of a phosphate deflocculant. According to this invention the synthetic hectorite advantageously contains, or is used in combination with, a larger quantity of flocculant than is usually used in conjunction with synthetic hectorite, namely at least 7.5%, particularly preferably at least 8.5%, by weight of the synthetic hectorite. Suitably the deflocculant is a polyphosphate or pyrophosphate deflocculant. The optimal range for retention in composition stability, is found to be 9.5% to 10.5% and the upper limit may be 15% or more. The increased-deflocculant synthetic hectorite may suitably be Laponite JS. Fluoride-containing synthetic clays may be used in combination with the increased quantity of deflocculant.

The polymeric binder is preferably, although not essentially, in the form of an emulsion latex. Many polymers cannot be emulsion polymerised but may be transferred from an organic medium into the form of an aqueous emulsion by emulsification of the medium followed by solvent stripping or phase inversion. The polymeric binder may be selected from suitable film-forming cross-linkable polymers such as polyesters, polyepoxides, vinyl polymers such as polypropylene, polybutadiene, polyisoprene, polyvinyl acetate or polyvinyl alcohol or, as indicated above, preferably from the polyurethanes or urethane copolymers. The polymeric binder may be helped to cure by using a catalyst if necessary although the last-mentioned polymers will normally cure without a catalyst and, when cross-linked, may provide particularly durable and transparent coatings.

The cross-linking agent which is added to the present composition is selected to be effective in relation to the particular polymer being used at temperatures which will not

harm the surface being treated in the time required for cure. Preferably, the cross-linking agent is selected to be capable of curing the polymer at temperatures below 150°C, particularly preferably below 140°C. It is generally preferred that the cross-linking agent be capable of achieving cure at temperatures above 10°C, particularly preferably above 50°C. The curing duration is preferably below 2 hours or, for cure temperatures above 100°C, no more than about 1.5 hours. A suitable minimum curing duration may be 10 minutes. Preferred curing agents are the polyaziridines, metal-containing curing agents, for example zirconium compounds such as ammonium zirconium carbonate or metal-organic compounds such as the amino-functional product synthesised with a stable preneutralised complex and available as Chartwell B515-4.

Polymer latices or dispersions for use in this invention preferably have a polymer concentration of from 1% to 5% particularly preferably from 2% to 4% by weight of the surface coating composition. The concentration of synthetic mineral, particularly of the synthetic clay mineral, should preferably be at least 0.5% and up to 12% by weight of the composition. The upper limit is set by the nature of the mineral and the viscosity required in the composition to attain a sufficiently thick coating. If the mineral is a gelling grade of synthetic hectorite clay mineral, such as Laponite RD, the concentration may be up to about 2% whereas, if it is a sol-forming peptiser-containing grade such as Laponite RDS, the concentration may be up to about 12% by weight, or more, of the composition.

It is found that the surface-coating composition of the invention may be fast to gel physically where the quantity of polymeric dispersion is relatively high, for example 10% or more, by weight of the composition. This may give rise to application problems. To lengthen the period of stability for a given application it may be necessary to reduce the concentration to no more than about 6%. It is found that if a quantity of a polar solvent such as propylene glycol is added, for example from 1% to 12% by weight of the composition the

stability period for a given concentration of dispersion is considerably increased. Where both a polar solvent and an increased quantity of deflocculant is used the period of stability may be at least 5 days. Such a composition is readily sprayable during this period.

The composition should preferably also contain an anionic or nonionic wetting agent. Examples of suitable wetting agents are the nonionic fluorosurfactants such as the 40% weight active product Zonyl FSN or the anionic polysiloxanes such as the polyether-modified product BYK 346. A suitable dispersant is a fully neutralised polycarboxylic acid such as Dispex N40. The quantity of the wetting agent or dispersant is preferably each at least 0.1% and, for example up to 5% by weight of the composition.

The substrate to be surface-treated according to this invention may be any plastic, glass or other artefact surface which, due to its high resistivity, for example more than 10^{13} ohms/m², may be subject to static accumulation. Such a surface may be of polyvinyl chloride, for example as a coating on a sheet or fabric or in the form of floor tiles or other formed articles, acrylic, styrene-acrylic, styrene acrylonitrile or acrylonitrile-butadiene-styrene copolymers (ABS) which may be in the form of sheets, polycarbonates or other plastics surfaces. The glass surface may be, for example, a television screen or computer monitor screen.

The substrate may be pre-treated to render it more amenable to coating by corona discharge in the case of PVC or glass, or by the use of a silane treatment. A layer of the composition according to the invention may be applied, for example by brushing, or by spraying particularly in the case of compositions containing a deflocculant and/or a polar organic solvent, preferably to a thickness of at least 20 micrometers and suitably up to 150 micrometers applied, in the case of coatings above 30 micrometers in thickness, in two or more layers with intervening drying. The coating may be dried by hot

air drying or by other means and may be crosslinked, as appropriate, by the application of heat or by the use ionising radiation or by other means. For heat-induced cross-linking of the composition on PVC, textiles or glass a temperature of up to about 150°C may be suitable while for the cross-linking on ABS or acrylics the temperature is preferably maintained at not more than about 85°C.

The conductivity of a surface coated with the composition may be judged by the decrease in the resistivity of the surface as measured, using a resistivity meter, in ohms per m². Preferably the decrease is at least 10³ but most preferably at least 10⁴ ohms/m².

The invention will now be illustrated by reference to the following Examples which are not intended to be limiting in any way on the scope of the invention.

The following are formulations of compositions according to the invention expressed in parts by weight.

Example 1

Whitcobond 223-8 polyurethane latex	10.0
Zeneca CX-100 aziridine crosslinker	0.2
Laponite RDS synthetic hectorite	7.5
Zonyl FSN wetting agent	0.5
Demineralised Water	81.8

The Laponite RDS is a sol-forming grade containing a gel retarding quantity of tetrasodium pyrophosphate. Laponite is a Trademark of Laporte Industries. Whitcobond is a Trademark of Baxenden Chemicals. Zonyl is a Trademark of Du Pont.

Example 2

Primal 358 acrylic latex	10.0
Zeneca CX-100 aziridine crosslinker	0.2
Laponite RDS synthetic hectorite	7.5
Zonyl FSN wetting agent	0.5
Demineralised Water	81.8

Primal is a trademark of Rohm and Haas

Example 3

Beetle BT 338 melamine resin	10.0
Chartwell B 515.4 crosslinker	0.3
Ammonium chloride (25% by weight)	1.0
Laponite RDS synthetic hectorite	7.5
Zonyl FSN wetting agent	0.5
Demineralised water	80.7

Beetle is a Trademark of BIP Speciality Resins.

The compositions described in Examples 1 to 3 were applied to some of following substrates and the water resistance and surface resistivity of the resulting films was assessed.

ABS

Acrylic

Styrene acrylic

Each of these substrates was coated as follows. Two 30 um coatings were applied with intervening drying by means of a hot air drier. The final coating was dried by the same means and the composite coating was cured at a temperature of 85°C to 87°C for 20 minutes.

Polycarbonate

The coatings were applied and dried as above and the composite coating was cured at a temperature of 73°C to 75°C for 20 minutes.

PVC-coated textile fabric

PVC tile

Glass

Each of these substrates was coated as follows. Two 60um coatings were applied and dried as above. The curing was conducted at a temperature of 130°C for 60 minutes.

The coating/substrate combinations are identified below.

Composition	Substrate	Resistivity
of Example No	coated	Ohms/m ²
1	PVC Tile	10 ⁸ to 10 ⁹

"	ABS	"
"	Acrylic	"
"	Styrene acrylic	"
"	Polycarbonate	"
2	PVC Fabric	"
3	Glass	$10^9 - 10^{12}$

All the coatings were resistant to repeated water-washings.

The formulations of further compositions according to the invention are as follows.

Example 4

Whitcobond 223-8 binder	10.00
CX-100 crosslinker	0.20
Laponite JS(10% tetrasodium pyrophosphate)	7.50
Zonyl FSN wetting agent	0.50
Dispex N40 dispersant	1.25
Propylene glycol	5.00
Demineralised water	75.55

Example 5

Whitcobond 223-8 binder	5.00
CX-100 crosslinker	0.20
Laponite RDS(6.5% tetrasodium pyrophosphate)	7.50
Zonyl FSN wetting agent	0.50
Dispex N40 dispersant	1.25
Propylene glycol	5.00
Demineralised water	80.55

Claims

1. A surface-coating composition, for application as a protective surface-coating to plastics or glass articles or equipment, the composition comprising a synthetic mineral capable of imparting conductive properties to the composition, a binder for the mineral comprising an aqueous emulsion, suspension or dispersion of a polymer and a low temperature cross-linking agent for the polymer.
2. A composition as claimed in claim 1 wherein the synthetic mineral is a synthetic hectorite containing hydroxyl groups.
3. A composition as claimed in claim 1 or 2 wherein the synthetic hectorite is fluoride-free.
4. A composition as claimed in any preceding claim wherein the synthetic hectorite is used in combination with a polyphosphate or pyrophosphate in a quantity of from 1% to 10% by weight thereof.
5. A composition as claimed in claim 4 wherein the quantity of polyphosphate or pyrophosphate is at least 7.5%.
6. A composition as claimed in any preceding claim wherein the synthetic hectorite is in from 0.5% to 12% by weight of the composition.
7. A composition as claimed in any preceding claim wherein the binder is an aqueous emulsion, suspension or dispersion of a urethane polymer or copolymer, an acrylic polymer or copolymer or a melamine resin.
8. A composition as claimed in any preceding claim wherein the low temperature cross-linking agent is capable of achieving cure within a period of from 10 minutes to 2 hours at a temperature in the range 50 to 140 degrees Centigrade.
9. A composition as claimed in any one of claims 1 to 7 containing a polar organic solvent.
10. A composition as claimed in any preceding claim wherein the low temperature cross-linking agent is a polyaziridine a zirconium compound or an organometallic compound.

11. A composition as claimed in any preceding claim also containing an anionic or nonionic wetting agent in from 0.1% to 5% by weight of the composition.

12. A composition as claimed in claim 1 comprising a synthetic hectorite, a deflocculant in at least 7.5% by weight of the synthetic hectorite, a polar organic solvent in at least 1% by weight of the composition, and a binder in at least 10 % by weight of the composition.

13. A composition as claimed in claim 12 wherein the deflocculant is present in at least 8.5% by weight of the synthetic hectorite.

14. A composition as claimed in any preceding claim and substantially as described herein with reference to any one of the Examples.

15. An article or equipment having a plastics or glass surface coated with a protective coating comprising a composition as claimed in any preceding claim in cured form.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)		Application number GB 9517111.2
Relevant Technical Fields (i) UK Cl (Ed.O) C3V (VABP, VABQ, VABR, VABS, VABT, VABX) (ii) Int Cl (Ed.6) C09D		Search Examiner K MACDONALD
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE: WPI		Date of completion of Search 31 JANUARY 1996 Documents considered relevant following a search in respect of Claims :- 1-15

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
X, Y	GB 2242682 A (BELZONA) Claims 1-11	X: at least Claims 1, 7, 10 Y: at least Claims 1, 2
X, Y	GB 2177413 A (BXL PLASTICS) Claims 1-7	X: at least Claims 1, 7, 10 Y: at least Claims 1, 2
Y	EP 0374937 A2 (KANZAKI) eg Example 7	at least Claims 1, 2
Y	EP 0211696 A1 (WIGGINS) Claim 1	at least Claims 1, 2

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Continuation page

Category	Identity of document and relevant passages	Relevant to claim(s)
X	US 5114481 (LYNCH) Claims 1, 8; column 8, lines 14-27	at least Claims 1, 2, 4-7, 9, 11, 12
X, Y	US 5041242 (CAPPAR) Claim 1; column 5 line 44	X: at least Claims 1, 7 Y: at least Claims 1, 2
X	WPI Abstract Accession No 94-238971/29 and JP 6172657 A (NIPPON SILICA) 21.06.94 (see abstract)	at least Claims 1, 2, 4-6
X	WPI Abstract Accession No 94-222209/27 and JP 6157947 A (MITSUBISHI) 07.06.94 (see abstract)	at least Claim 1
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X	WPI Abstract Accession No 91-257863/35 and JP 3169540 A (KANZAKI) 23.07.91 (see abstract)	at least Claims 1, 2, 4-7, 9, 11, 12

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